# FIITJEE

# ALL INDIA TEST SERIES

# CONCEPT RECAPITULATION TEST – I

# JEE (Advanced)-2020

## PAPER – 2

**Time Allotted: 3 Hours** **Maximum Marks: 183**

**General Instructions:**

- The test consists of total 54 questions.
- Each subject (PCM) has 18 questions.
- This question paper contains **Three Parts.**
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each **Part** is further divided into **One Section**: **Section-A.**

1. ***Section–A (01 – 07, 19 – 25, 37 – 43)*** *contains 21 multiple choice questions which have* ***only one correct answer****. Each question carries* ***+3 marks*** *for correct answer and* ***–1 mark*** *for wrong answer.*

   ***Section-A (08– 14, 26 – 32, 44 – 50)*** *contains 21 multiple choice questions which have* ***one or more than one correct*** *answer. Each question carries* ***+4 marks*** *for correct answer and* ***–2 marks*** *for wrong answer*
   Partial Marks **+1** for each correct option provided no incorrect option is selected.

   ***Section–A (15 – 18, 33 – 36, 51 – 54)*** *contains 6 paragraphs. Each paragraph is having 2 multiple choice questions having 4 options with* ***only one correct answer****. Each question carries* ***+3 marks*** *for correct answer. There is no negative marking.*

# Physics

## PART – I

### SECTION – A
### (One Options Correct Type)

This section contains **07 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

1. The height at which the acceleration due to gravity decreases by 36% of its value on the surface of the earth. (The radius of the earth is R)

(A) $\frac{R}{6}$ (B) $\frac{R}{4}$

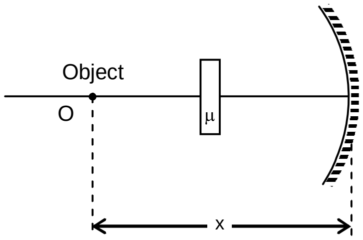
(C) $\frac{R}{2}$ (D) $\frac{2}{3}R$

2. A string of mass m is fixed at both ends. The fundamental tone oscillation are excited in the string with angular frequency $\omega$ and maximum displacement amplitude A. Find the total energy contained in the string.

(A) $\frac{1}{2}m\omega^2A^2$ (B) $\frac{1}{4}m\omega^2A^2$

(C) $\frac{1}{6}m\omega^2A^2$ (D) $\frac{1}{8}m\omega^2A^2$

3. A glass slab of thickness t = 3 cm, R.I. $\mu = \frac{3}{2}$ is placed between the object O and the concave mirror of focal length f = 4.5 cm. It is observed that the image is formed at the object. If we withdraw the slab, the image will be formed at a distance of



(A) 10 cm/11 (B) 30 cm/11

(C) 80 cm/11 (D) 90 cm/11

*Space for Rough work*

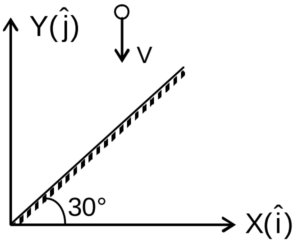
4. When a beam of accelerated electrons hits a target, a continuous X-ray spectrum is emitted from the target. Which of the following wavelength is absent in the X-ray spectrum, if the X-ray tube is operating at 40.000 volts?

(A) 0.25 Å (B) 0.5 Å
(C) 1.5 Å (D) 1.0 Å

5. The electric potential between a proton and an electron is given by $V = V_0 \ln\frac{r}{r_0}$, where $r_0$ is a constant. Assuming Bohr's model to be applicable, write variation of $r_n$ with n, n being the principal quantum number.

(A) $r_n \propto n$ (B) $r_n \propto 1/n$
(C) $r_n \propto n^2$ (D) $r_n \propto 1/n^2$

6. An object moves with velocity $V(-\hat{j})$ towards the inclined plane mirror as shown in figure. The velocity of the image is



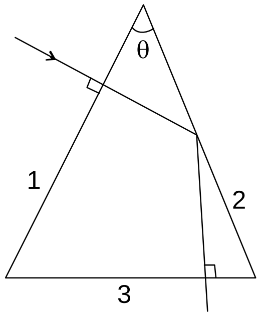
(A) $V\,\hat{j}$

(B) $V\frac{\sqrt{3}}{2}(-\hat{i}) + \frac{V}{2}\hat{j}$

(C) $V\frac{\sqrt{3}}{2}\hat{i} + \frac{V}{2}\hat{j}$

(D) $\frac{V}{2}(-\hat{i}) + V\frac{\sqrt{3}}{2}(\hat{j})$

7. A ray of light enters into the prism normally with the face-1 and comes out normally with the face-3. The minimum R.I. of the prism is



(A) cosec $\frac{\theta}{2}$ (B) tan θ
(C) sec θ (D) cosec θ

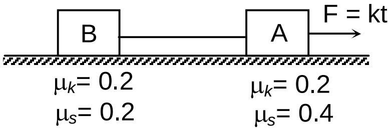
**Space for Rough work**

## (One or More than one correct type)

This section contains **07** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

8. A horizontal disc rotates freely about a vertical axis through its centre. A ring, having the same mass and radius as the disc, is now gently placed on the disc. After some time, they rotate with a common angular speed.
(A) some friction exists between the disc and the ring.
(B) the angular momentum of the disc plus ring is conserved.
(C) the final common angular speed is $\frac{2}{3}$rd of the initial angular velocity of the disc.
(D) $\frac{2}{3}$ rd of the initial kinetic energy changes to heat.

9. Two block *A* and *B* each of mass $\frac{1}{2}$ kg is connected by a massless inextensible string and kept on horizontal surface. Coefficient of friction between block and surface shown in figure. A force $F = kt$ (where *k* = 1 N/s and *t* is time in second) applied on *A.* Then (g = 10 m/s$^2$)

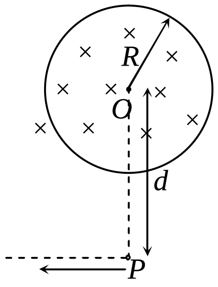


(A) work done by friction force on block *B* is zero in time interval *t* = 0 to *t* = 3s.
(B) work done by friction force on block *A* is zero in time interval *t* = 0 to *t* = 3s.
(C) work done by tension on *B* is also zero in time interval *t* = 0 to *t* = 3s.
(D) speed of blocks at *t* = 10s is 27.5 m/s.

10. If electron of the hydrogen atom is replaced by another particle of same charge but of double the mass, then:
(A) Bohr radius will increase
(B) ionisation energy of the atom will be doubled
(C) speed of the new particle in a given state will be lesser than the electron's speed in same orbit
(D) gap between energy levels will now be doubled

***Space for Rough work***

11. In a cylindrical region of radius R, there exists a time varying magnetic field B such that $\frac{dB}{dt} = k(>0)$. A charged particle having charge q is placed at the point P at a distance d (> R) from its centre O. Now, the particle is moved in the direction perpendicular to OP (see figure) by an external agent upto infinity so that there is no gain in kinetic energy of the charged particle. Choose the correct statement/s.



(A) Work done by external agent is $\frac{q\pi R^2}{4}k$ if d = 2R

(B) Work done by external agent is $\frac{q\pi R^2}{8}k$ if d = 4R

(C) Work done by external agent is $\frac{q\pi R^2}{4}k$ if d = 4R

(D) Work done by external agent is $\frac{q\pi R^2}{4}k$ if d = 6R

12. Two projectile are thrown at the same time from two different points. The projectile thrown from the origin has initial velocity $3\hat{i} + 3\hat{j}$ with respect to earth. The projectile has initial velocity $a\hat{i} + b\hat{j}$ with respect to earth thrown from the point (10, 5). ($\hat{i}$ is a unit vector along horizontal, $\hat{j}$ along vertical). If the projectile collides after two second, then the

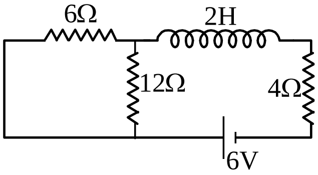
(A) value of a is -2

(B) value of a is $\frac{1}{2}$

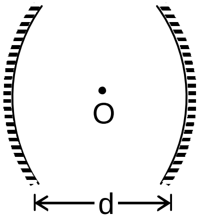
(C) value of b is $\frac{1}{2}$

(D) value of b is –2

***Space for Rough work***



13. For the circuit shown in the figure, which of the following statements is/are correct
(A) Its time constant is 0.25 second
(B) In steady sate, current through inductance will be equal to zero.
(C) in steady state, current through the battery will be equal to 0.75 amp.
(D) none of these



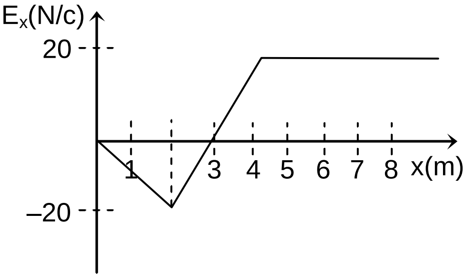
14. The distance d between two identical concave mirrors of radius of curvature R. So, as to coincide the image I on the object O itself, which is placed at the mid point can be
(A) R (B) 2R
(C) 3R (D) R/2

## Paragraph Type (One Option Correct)

This section contains **02 paragraph** each describing theory, experiment, data etc. **Four questions** relate to the paragraph. Each question of a paragraph has **Only One correct** answer among the four choices (A), (B), (C) and (D).

### Paragraph for Question Nos. 15 and 16

A graph of the x-component of the electric field as a function of x in a region of space is shown in the figure. The y and z-components of the electric field are zero in this region. The electric potential at the origin is zero.



15. The electric potential at x = 2m is:
(A) 10 V (B) 20 V
(C) 30 V (D) 40 V

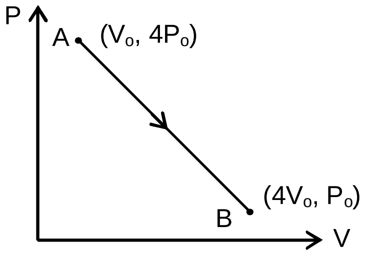
***Space for Rough work***

16. The greatest positive value of electric potential for points of the x-axis for which $0 \le x \le 6\text{m}$ is:

(A) 10 V
(B) 20 V
(C) 30 V
(D) 40 V

### Paragraph for Question Nos. 17 and 18

Consider a monoatomic ideal gas undergoing a process AB as shown in figure.



17. Find the maximum temperature of the gas if temperature at A is $T_o$.

(A) $\frac{21}{16}T_o$
(B) $\frac{23}{16}T_o$
(C) $\frac{25}{16}T_o$
(D) $\frac{27}{16}T_o$

18. Volume at which rate of heat exchange is zero.

(A) $\frac{19}{8}V_o$
(B) $\frac{21}{8}V_o$
(C) $\frac{23}{8}V_o$
(D) $\frac{25}{8}V_o$

***Space for Rough work***

# *Chemistry* PART – II

## SECTION – A

### (One Options Correct Type)

This section contains **07 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

19. The incorrect statement for $I_3^-$ ion is:

(A) The central iodine atom undergoes $sp^3d$ hybridization
(B) It is a linear ion.
(C) The central atom contains no lone pair.
(D) The electron in the hybridized d-orbital, forms sigma bond.

20. $HCN(aq) \rightleftharpoons H^+(aq) + CN^-(aq)$

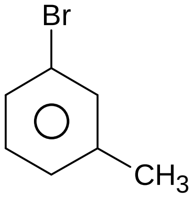
Which of the following characteristic of the above system increases by increasing temperature?

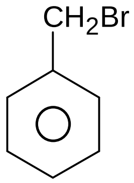
(A) $K_a$
(B) $p^{K_a}$
(C) pH
(D) $K_b$ of $CN^-$

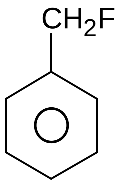
21. Which of the following characteristic of a chemical reaction decreases by increasing temperature?

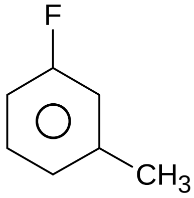
(A) Temperature coefficient
(B) Hal-life period
(C) Rate constant
(D) Activation energy

22. Which of the following compound is most reactive towards $OH^-$ ion through $S_N1$ path?

(A)


(B)


(C)


(D)


*Space for Rough work*

23. Aqueous solution of which of the following complex has maximum conductivity?

(A) $[Fe(H_2O)_4Cl_2]Cl$
(B) $[Fe(H_2O)_5Cl]Cl_2$
(C) $[Fe(H_2O)_6]Cl_3$
(D) $[Fe(H_2O)_3Cl_3]$

24. $CH_3CH_2NH_2 + CHCl_3 \xrightarrow{KOH} \text{Product}$

The organic product of above reaction is:

(A) $CH_3CH_2CN$
(B) $CH_3CH_2NC$
(C) $CH_3CH_2Cl$
(D) $CH_3CH_2CH_3$

25. How many coordination isomer(s) is/are possible for the following complex?

$[Cr(NH_3)_6][Co(CN)_6]$

(A) 4
(B) 7
(C) 5
(D) 8

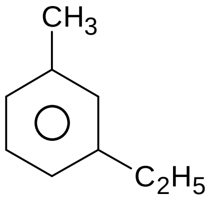
### (One or More than one correct type)

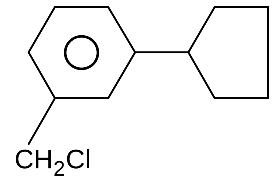
This section contains **07** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

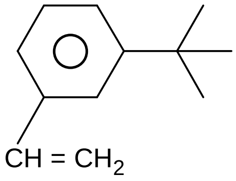
26. Which expressions are correct for a real gas at extremely high pressure?

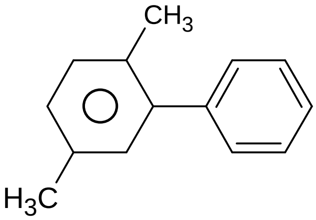
(A) PV = RT + Pb
(B) Z > 1
(C) $a \simeq 0$
(D) PV > nRT

27. Which of the following compound(s) form dicarboxylic acid(s) on alkaline permanganate oxidation?

(A)


(B)


(C)


(D)


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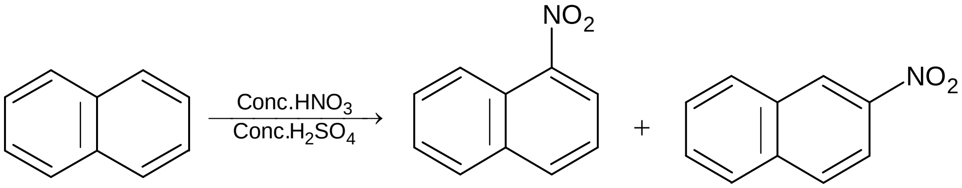
28. 

Which of the following statement(s) is/are correct for the above product(s)?
(A) $\alpha$-nitronaphthalene is the major product
(B) $\beta$- nitronaphthalene is the minor product
(C) for $\beta$-nitronaphthalene two of the sigma complexes display aromaticity.
(D) for $\alpha$-nitronaphthalene two of the sigma complexes display aromaticity.

29. Which of the following reaction(s) undergo disproportionation?
(A) $H_3PO_3 \xrightarrow{\Delta}$
(B) $P_4 + NaOH \longrightarrow$
(C) $H_2SO_4 + C_6H_{12}O_6 \xrightarrow{\Delta}$
(D) $H_2O_2 \xrightarrow{\Delta}$

30. In which of the following reaction(s) heat is always evolved?
(A) Neutralization reactions
(B) Hydrogenation reactions
(C) Dehydration reactions
(D) Synthesis reactions

31. Which of the following property/properties of a solid change(s) due to Frenkel defect?
(A) Density decreases
(B) Melting point decreases
(C) Conductivity increases
(D) Density increases

32. At pH = 4, glycine exists as
(A) $NH_2 - CH_2 - COOH$
(B) $\overset{+}{N}H_3 - CH_2 - COO^-$
(C) $\overset{+}{N}H_3 - CH_2 - COOH$
(D) $NH_2 - CH_2 - COO^-$

***Space for Rough work***

## Paragraph Type (One Option Correct)

This section contains **02 paragraph** each describing theory, experiment, data etc. **Four questions** relate to the paragraph. Each question of a paragraph has **Only One correct** answer among the four choices (A), (B), (C) and (D).

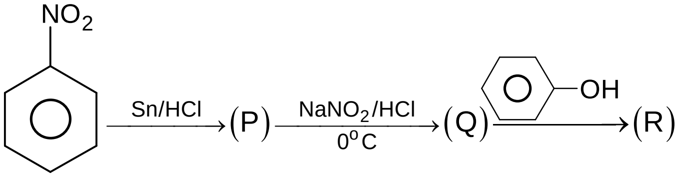
### Paragraph for Question Nos. 33 and 34

An aqueous solution of $CuSO_4$ was prepared by completely dissolving 25.52 g of anhydrous copper sulphate in 401.08 mL water. The resulting solution was electrolyzed by passing 193 ampere current for one minute through platinum electrodes. In the process, a certain amount of copper gets deposited at cathode and $O_2$ gas is evolved at anode.
[Mol. mass of $CuSO_4$ = 159.5 g $mol^{-1}$]
Answer the following questions on the basis of above write up.

33. What is the molarity of the solution after electrolysis?
(A) 0.4 M (B) 0.25 M
(C) 0.15 M (D) 0.32 M

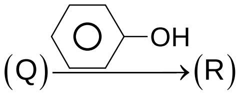
34. The mass of $O_2$ gas liberated at anode is:
(A) 0.32 g (B) 0.48 g
(C) 0.96 g (D) 0.16 g

### Paragraph for Question Nos. 35 and 36



Answer the following questions on the basis of above reaction sequence.

35. How many pi-bond(s) is/are present in one molecule of (R)?
(A) 4 (B) 6
(C) 7 (D) 8

36.


The yield of (R) according to the above reaction will be maximum if the pH of the solution is:
(A) 3 (B) 4
(C) 8 (D) 13

***Space for Rough work***

# Mathematics

## PART – III

### SECTION – A
(One Options Correct Type)

This section contains **07 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

37. If $1, \alpha_1, \alpha_2, \alpha_3, \alpha_4$ are the fifth roots of unity then $\sum_{r=1}^{4} \frac{1}{2-\alpha_r} =$

(A) $\frac{51}{31}$ (B) $\frac{49}{31}$

(C) $\frac{25}{32}$ (D) $\frac{25}{16}$

38. If $\alpha, \beta$ and $\gamma$ are three real roots of the equation $x^3 - 6x^2 + 5x - 1 = 0$, then the value of $\alpha^4 + \beta^4 + \gamma^4$ is:

(A) 250 (B) 650

(C) 150 (D) 950

39. If $\alpha, \beta, \gamma$ are roots of equation $x^3 - 2x^2 - 1 = 0$ and $T_n = \alpha^n + \beta^n + \gamma^n$, then value of $\frac{T_{11} - T_8}{T_{10}}$ is equal to

(A) 1 (B) 2

(C) –1 (D) 3

40. If $f(x) = \left(1 + \frac{1}{x}\right)^x$ then $\lim_{n\to\infty} \left\{ f\left(\frac{1}{n}\right).f\left(\frac{2}{n}\right).f\left(\frac{3}{n}\right)....f\left(\frac{n}{n}\right) \right\}^{1/n}$ equals:

(A) $\sqrt{2}e$ (B) $\sqrt{2e}$

(C) $2\sqrt{e}$ (D) $\sqrt{e}$

***Space for Rough work***

41. If it is known that $f'\left(\frac{2^x - 2^{-x}}{2^x + 2^{-x}}\right) > 0 \, \forall \, x \in R$, then function $g(x) = f\left(e^x\right)$ is necessarily increasing on:

(A) $x \in \left(-\frac{1}{2}, \frac{1}{2}\right)$
(B) $x \in \left(\frac{1}{2}, \infty\right)$
(C) $x \in (-\infty, 0)$
(D) $x \in (-\infty, e)$

42. For the line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$, which one of the following is incorrect?

(A) it lies in the plane $x - 2y + z = 0$
(B) it is same as line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$
(C) it passes through (2, 3, 5)
(D) it is parallel to the plane $x - 2y + z - 6 = 0$

43. From a pack of 52 playing cards; half of the cards are randomly removed without looking at them. From the remaining cards, 3 cards are drawn randomly. The probability that all are king

(A) $\frac{1}{(25)(17)(13)}$
(B) $\frac{1}{(25)(15)(13)}$
(C) $\frac{1}{(52)(17)(13)}$
(D) $\frac{1}{(13)(51)(17)}$

***Space for Rough work***

## (One or More than one correct type)

This section contains **07** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

44. For $k \in N$, let $b_k = \int_1^e \frac{1}{(k+\log x)(k+1+\log x)}\frac{dx}{x}$ and $a_n = \sum_{k=1}^{n} b_k$. Then

(A) $b_k = \log\left(\frac{(k+1)^2}{k(k+2)}\right)$

(B) $a_n = \log\left(\frac{2n+2}{n+2}\right)$

(C) $\lim_{n\to\infty} a_n = \log 2$

(D) $\lim_{n\to\infty} a_n < 1$

45. There exists a triangle ABC satisfying

(A) $\tan A + \tan B + \tan C = 0$

(B) $\frac{\sin A}{2} = \frac{\sin B}{3} = \frac{\sin C}{7}$

(C) $(a+b)^2 = c^2 + ab$ and $\sqrt{2}(\sin A + \cos A) = \sqrt{3}$

(D) $\sin A + \sin B = \frac{\sqrt{3}+1}{2}$, $\cos A \cos B = \frac{\sqrt{3}}{4} = \sin A \sin B$

46. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be vectors forming right hand triad. Let $\vec{p} = \frac{\vec{b}\times\vec{c}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}$, $\vec{q} = \frac{\vec{c}\times\vec{a}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}$ and $\vec{r} = \frac{\vec{a}\times\vec{b}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}$. If $x \in R^+$, then

(A) $x\left[\vec{a}\ \vec{b}\ \vec{c}\right] + \frac{\left[\vec{p}\ \vec{q}\ \vec{r}\right]}{x}$ has least value 2

(B) $x^4\left[\vec{a}\ \vec{b}\ \vec{c}\right]^2 + \frac{\left[\vec{p}\ \vec{q}\ \vec{r}\right]}{x^2}$ has least value $\left(\frac{3}{2^{\frac{2}{3}}}\right)$

(C) $\left[\vec{p}\ \vec{q}\ \vec{r}\right] > 0$

(D) none of the above

***Space for Rough work***

47. The solution of $y_1\left(x^2y^3+xy\right)=1$ is

(A) $\frac{1}{x}=2-y^2+Ce^{-y^2/2}$

(B) the solution of an equation which is reducible to linear equation

(C) $\frac{2}{x}=1-y^2+e^{-y/2}$

(D) $e^{y^2/2}\left(\frac{1-2x}{x}+y^2\right)=C$

48. Consider the functions $f(x)$ and $g(x)$, both defined from $R \to R$ and are defined as $f(x)=2x-x^2$ and $g(x)=x^n$ where $n \in N$. If the area between $f(x)$ and $g(x)$ in first quadrant is $\frac{1}{2}$ then n is a divisor of

(A) 12 (B) 15
(C) 20 (D) 30

49. If $S_r=\sqrt{r+\sqrt{r+\sqrt{r+\sqrt{.....\infty}}}}$, $r>0$ then which the following is/are correct.

(A) $S_2, S_6, S_{12}, S_{20}$ are in AP (B) $S_4, S_9, S_{16}$ are irrational
(C) $\left(2S_4-1\right)^2, \left(2S_5-1\right)^2 \left(2S_6-1\right)^2$ are in AP (D) $S_2, S_{12}, S_{56}$ are in GP

50. Let a, b, c be the sides of triangle ABC such that $2b=a+c$. If

$$\frac{2!}{1!9!}+\frac{2!}{3!7!}+\frac{1!}{5!5!}=\frac{8^a}{(2c)!}, \quad \text{then}$$

(A) area of $\Delta ABC$ is 6 (B) circumradius of $\Delta ABC$ is 5
(C) inradius of $\Delta ABC$ is 1 (D) $\Delta ABC$ is right angled triangle

***Space for Rough work***

## Paragraph Type (One Option Correct)

This section contains **02 paragraph** each describing theory, experiment, data etc. **Four questions** relate to the paragraph. Each question of a paragraph has **Only One correct** answer among the four choices (A), (B), (C) and (D).

### Paragraph for Question Nos. 51 and 52

Suppose f, g and h be three real valued functions defined on R. Let
$f(x) = 2x + |x|$, $g(x) = \frac{1}{3}(2x - |x|)$ and $h(x) = f(g(x))$

51. The range of the function $k(x) = 1 + \frac{1}{\pi}\left(\cos^{-1}(h(x)) + \cot^{-1}(h(x))\right)$ is equal to:

(A) $\left[\frac{1}{4}, \frac{7}{4}\right]$
(B) $\left[\frac{5}{4}, \frac{11}{4}\right]$
(C) $\left[\frac{1}{4}, \frac{5}{4}\right]$
(D) $\left[\frac{7}{4}, \frac{11}{4}\right]$

52. The domain of definition of the function $I(x) = \sin^{-1}(f(x) - g(x))$ is equal to:

(A) $\left[\frac{3}{8}, \infty\right)$
(B) $(-\infty, 1]$
(C) $\left(-\infty, \frac{3}{8}\right)$
(D) $\left(-\infty, \frac{3}{8}\right]$

### Paragraph for Question Nos. 53 and 54

Each side of a square has length 4 units and its centre is at (3, 4). If one of the diagonals is parallel to the line $y = x$, then answer the following questions.

53. The radius of the circle inscribed in the triangle formed by any three vertices is:

(A) $2\sqrt{2}\left(\sqrt{2}+1\right)$
(B) $2\sqrt{2}\left(\sqrt{2}-1\right)$
(C) $2\left(\sqrt{2}+1\right)$
(D) none of these

54. The radius of the circle inscribed in the triangle formed by any two vertices of square and the centre is:

(A) $2\left(\sqrt{2}-1\right)$
(B) $2\left(\sqrt{2}+1\right)$
(C) $\sqrt{2}\left(\sqrt{2}-1\right)$
(D) none of these

***Space for Rough work***